Title: DEVICE FOR HEAT EXCHANGE
AND METHOD FOR PRODUCING
ONE SUCH DEVICE
Inventor(s): Gerrit WÖLK
DOCKET NO.: 016906-0536

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Fig. 1
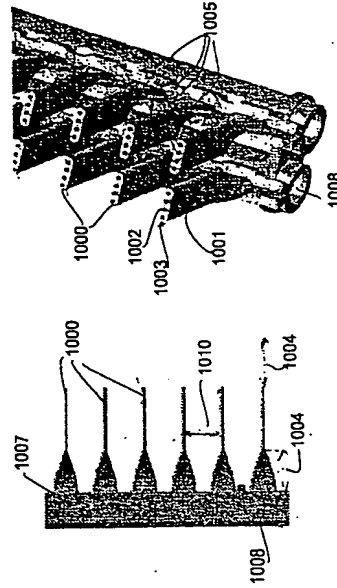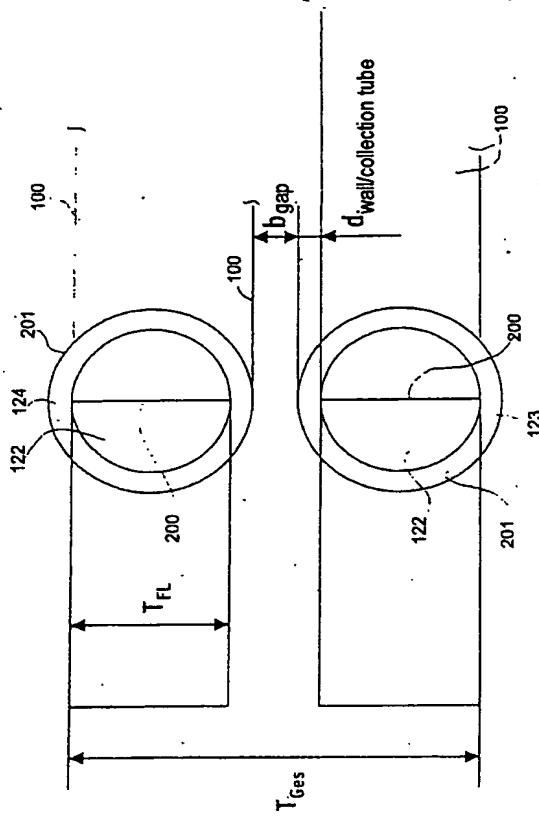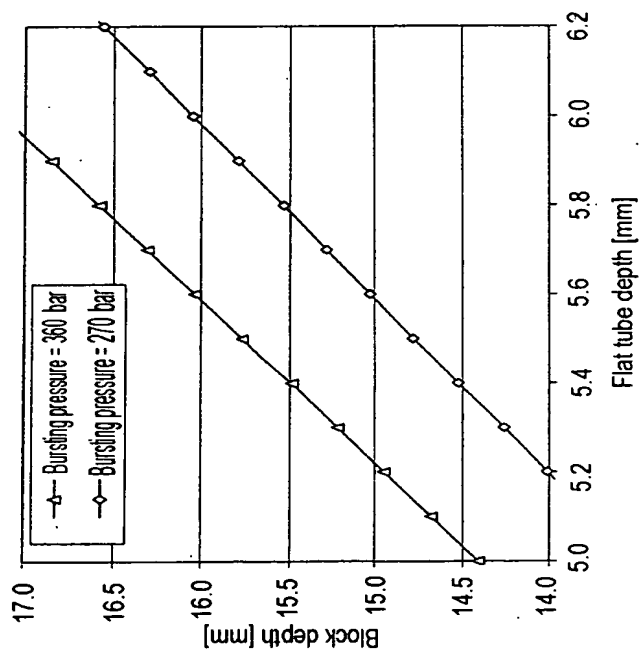
Fig. 10
State of the art

Fig. 2

$$T_{Ges} = 2 \times T_{FL} + 2 \times d_{wall, collection\ tube} + b_{gap}$$

where

$$b_{gap} = 0.8 \text{ mm}$$

$$d_{wall/collection\ tube} = 0.1 * P_{burst} * T_{FL}/(2*\sigma)$$

where P_{burst} is the bursting pressure and σ is the limit of elasticity of the collection tube material. Here $\sigma = 50$ N/mm^2

Fig. 3

Fig. 4

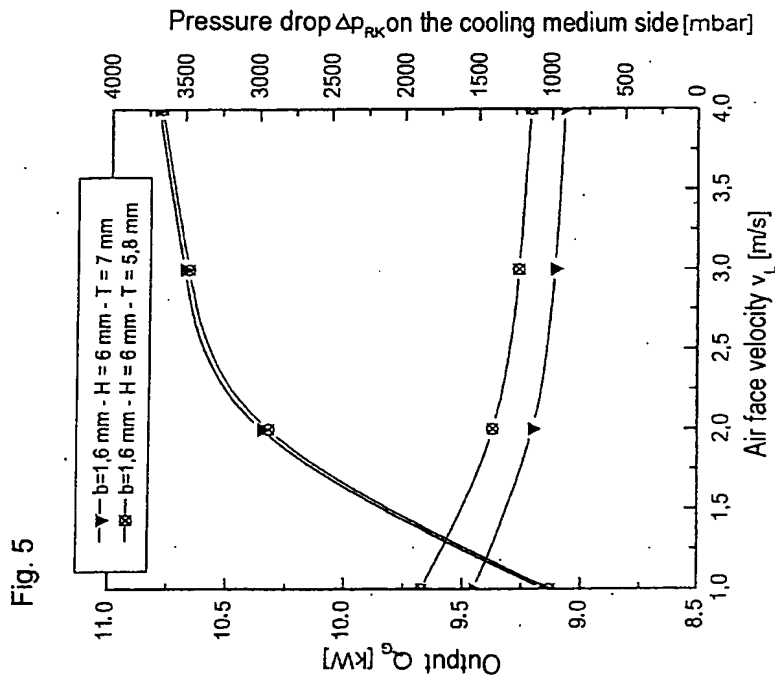$$T_{FL} = \frac{(T_{Ges} - b_{gap})}{2 + 0.2 * P_{burst}/(2*\sigma)}$$

where

$b_{gap} = 0.8$ mm

where P_{burst} is the bursting pressure and σ is the limit of elasticity of the collection tube material. Here $\sigma = 50$ N/mm^2

Flat tube depth [mm] vs Block depth [mm]

Bursting pressure = 360 bar
Bursting pressure = 270 bar

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Gas cooler:

Rib density 75 ri/dm
Rib height = 6 mm

Tube: T = 7 mm
B x H = 462.0 x 650 mm² F_{St} = 30.0 dm²
(1) HV   29/31 - 31/29

Tube: T = 5.8 mm
B x H = 462.0 x 664 mm² F_{St} = 30.7 dm²
(2) HV   29/31 - 31/29

Marginal conditions:
Air temperature gas cooler inlet: TLGE = 45°C
CO_2 temperature gas cooler inlet: TRGE = 130°C
Gas cooler inlet pressure: PRGE = 125 bar
Mass flow rate CO_2:   GR = 180 kg/h
Oil proportion: 1%

Fig. 5

Pressure drop Δp_{RK} on the cooling medium side [mbar]

Air face velocity v_L [m/s]

Output Q_G [kW]

Legend:
—▶— b=1.6 mm - H = 6 mm - T = 7 mm
—⊠— b=1.6 mm - H = 6 mm - T = 5,8 mm

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Fig. 6

Gas cooler:
Rib density 75 ri/dm
Rib height = 6 mm

Tube: T=7 mm
B x H = 458.8 x 650 mm² F_{St} = 29.8 dm²
(1) HV   37/40 - 40/37

Tube: T=5,8 mm
B x H = 458.8 x 664 mm² F_{St} = 30.5 dm²
(2) HV   37/40 - 40/37

Marginal conditions:
Air temperature gas cooler inlet: TLGE = 45°C
CO_2 temperature gas cooler inlet: TRGE = 130°C
Gas cooler inlet pressure: PRGE = 125 bar
Mass flow rate CO_2:   GR = 180 kg/h
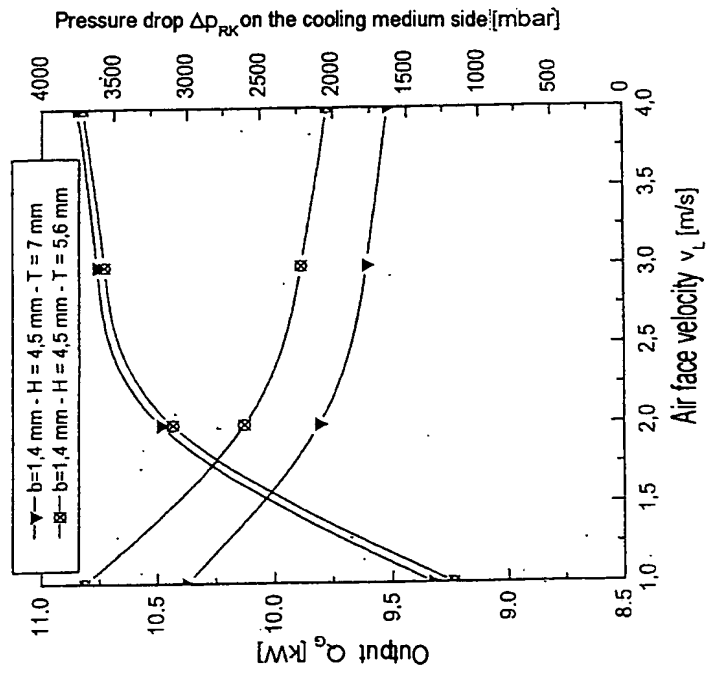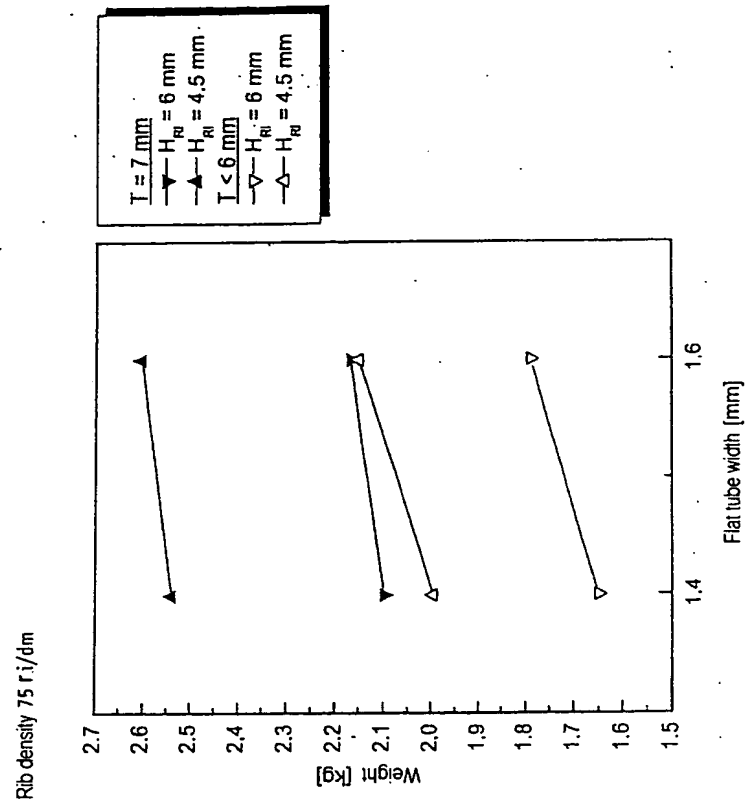Oil proportion: 1%

Pressure drop Δp_{RK} on the cooling medium side [mbar]

Air face velocity v_L [m/s]

Output Q_G [kW]

Legend:
— b=1,4 mm · H = 4,5 mm · T = 7 mm
— b=1,4 mm · H = 4,5 mm · T = 5,6 mm

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Fig. 7

Fig. 8

Gas cooler

Rib density 75 r i/dm
Rib height ▪ 6 mm

Tube: T=7 mm
B x H ▪ 462.0 x 650 mm² F_{St} ▪ 30.0 dm²
(1) HV   29/31 - 31/29

Tube: T=5.8 mm
B x H ▪ 462.0 x 664 mm² F_{St} ▪ 30.7 dm²
(2) HV   29/31 - 31/29

Marginal conditions:
Air temperature gas cooler inlet: TLGE ▪ 45°C
CO_2 temperature gas cooler inlet: TRGE ▪ 130°C
Gas cooler inlet pressure: PRGE ▪ 125 bar
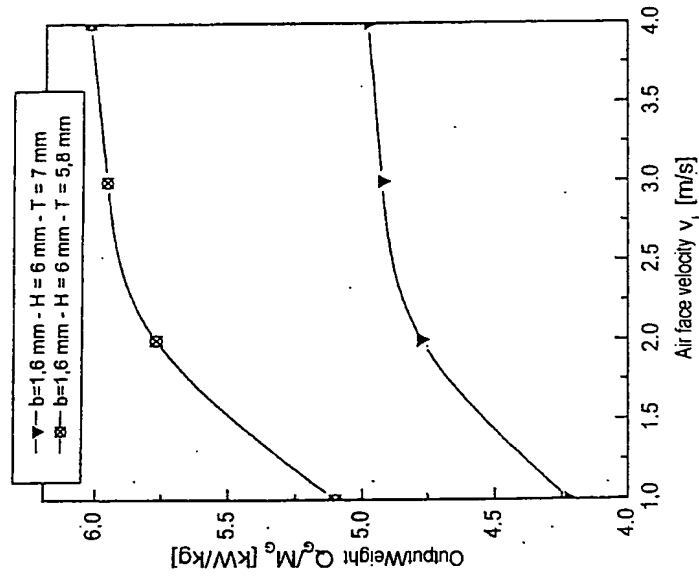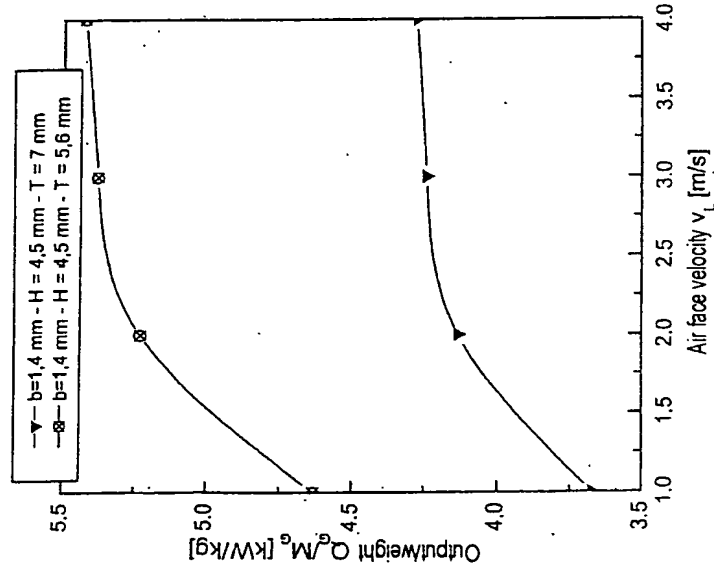Mass flow rate CO_2 :   GR ▪ 180 kg/h
Oil proportion: 1%

Legend:
▼ b=1,6 mm · H = 6 mm · T = 7 mm
⊗ b=1,6 mm · H = 6 mm · T = 5,8 mm

x-axis: Air face velocity v_L [m/s]
y-axis: Output/Weight Q_g/M_G [kW/kg]

Gas cooler:

Rib density 75 ri/dm
Rib height – 6 mm

Tube: T=7 mm
B x H = 458.8 x 650 mm² F_{St} – 29.8 dm²
(1) HV   37/40 – 40/37

Tube: T=5.8 mm
B x H = 458.8 x 664 mm² F_{St} – 30.5 dm²
(2) HV   37/40 – 40/37

Marginal conditions:

Air temperature gas cooler inlet: TLGE – 45°C
CO_2 temperature gas cooler inlet: TRGE – 130°C
Gas cooler inlet pressure: PRGE – 125 bar
Mass flow rate CO_2 :   GR – 180 kg/h
Oil proportion: 1%

Fig. 9